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AUTHOR Stewart, David W.
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ABSTRACT

A review of the general literature on diffusion, innovation, and social change is worthwhile as a basis for developing more effective methods for facilitating the adoption of computer-based technologies. Much of the research on diffusion has focused on (1) characteristics of the innovation which influence the diffusion process, (2) a description of the adoption process over time, and (3) characteristics of both individual innovators and innovative organizations. Once innovators in an organization have been identified, information should be supplied to them, emphasizing the relative advantages of the innovation, i.e., computer-based technologies, and a trial and error period should be provided. Developing internal advocates and insuring trial do not complete the adoption process, however, and resistance may still be substantial. Approaches to reduce resistance can include establishment of work teams, modification of organizational procedures to encourage use of computer technologies, and consideration of human factors. Those charged with implementation of these technologies can benefit from a review of the work of consumer psychologists and others involved in new product marketing. The current computer revolution will be painful and disconcerting to some, threatening to many, and will have an impact on nearly everyone. Psychologists can employ their knowledge to facilitate the inevitable transition to a computer-oriented society. (LMM)

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# The Diffusion of Innovations: A Review of Research and Theory with Implications for Computer Technology

by
David W. Stewart

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The Diffusion of Innovations: A Review of Research and Theory With Implications for Computer Technology

The computer and the technologies that have accompanied it have initiated a revolution in the manner in which people and organizations deal with information. Computers have provided a means for great power in statistical analysis, decision systems, record keeping and information storage, and training and instruction programs. The computer has found its way into every conceivable type of institution: commercial businesses, government, educational institutions, health care organizations and increasingly, even the home. Personal, home computers have recently become available and promise to radically alter certain types of behavior. Yet, the computer has remained a rather frightening machine to the majority of citizens. In large measure the computer remains in the hands of specialists who serve as intermediaries between the computer and the larger world. Each of foregoing papers (Young 1982, Flanagan 1982, Dos Santos 1982) provides examples of the problems associated with gaining acceptance of the computer by non-computer specialtists. Other examples of resistance to the use of computers are easy to find. These examples range from resistance to automatic teller machines installed by banks to the reluctance of physicians and other health care professionals to use computerized record systems. Lucus (1975) in a review of the literature on information systems has suggested that there has been too much concentration on technology while ignoring crucial individual and organizational behavior problems. Each of the foregoing papers has addressed these latter issues.

Despite the growth and the much heralded advantages of computer based technologies significant problems of acceptance still exist. Keen (1976) captured the essence of the problems:

> Technicians in the computer field have concentrated on design independent of implementation, assuming that the power of a good idea is enough to assure its adaptation.
>
> Reality is painfully different. "Good" ideas are not always accepted. Change is slow and invariably incremental, requiring nurture and constant facilitation. It cannot be mandated. The introduction of any technical innovation into an organization brings uncertainty — even threat — and makes effective, established routines obsolete.

Each of the presentations today has dealt with these problems of implementation in a specific setting. Some common themes have been struck, however. These same themes have been echoed elsewhere (Demb 1979, Lucus 1975, Ligon 1978, and Kenney 1978). In fact, the same problems and issues arise in almost every case involving social change. Social psychologists, sociologist, anthropologists, and students of consumer behavior have long been concerned with issues related to changing behavioral patterns associated with technological innovation. It appears worthwhile to review the general literature on diffusion, innovation, and social change, as a basis for developing more effective methods for facilitating the adoption of computer based technologies.

The diffusion process has been defined "as the acceptance, over time, of some specific item - an idea or practice, by individuals, groups, or other adopting units, linked to specific channels of communication, to a social structure, and a given system of values, or culture" (Katz, Levin, and

Hamilton, 1963). Much of the research on this topic has focused on three topics: 1) characteristics of the innovation which influence the diffusion process, 2) a description of the process of adoption over time, and 3) characteristics of innovators, including both individual innovators and innovative organizations.

Ostlund (1974), in a now classic study, investigated the relationships among attributes of an innovation and the probability the innovation would be adopted. Among the characteristics related to innovation were relative advantage, complexity, compatibility, trialability, divisibility, reversibility, communicability, adaptability, cost, realization, and risk. The impact of these attributes on the adoption of computer based technologies is readily apparent from a review of the history of computer applications in organizations. Gibson and Nolan (1974) identified four stages of electronic data processing growth: 1) Stage 1: Cost-reduction accounting applications such as payroll, accounts receivable and payable and billing; 2) Stage 2: Proliferation of applications in all functional areas; 3) Stage 3: Moratorium on new applications; emphasis on control; and 4) Stage 4: Data-base applications such as simulation models, query systems, etc. The emphasis in the first stage is on applications to routine problems where important cost reductions can be obtained through the use of the computer. The relative advantages of the computer in this case are clear: cost reduction, elimination of personnel, and the faster turn-around of routine functions. These advantages are quickly realized, easily communicated, and the risk is relatively low since if the system fails the functions can be completed by hand or some other means already well known and in use in the organization. Early on in the process the system can be tried out on a limited basis with the ever-present option of returning to the old way of doing things. Since

the functions performed at this stage are relatively mechanical, the use of a machine to accomplish the tasks is quite compatible with the way people perceive these tasks and few changes in organizational procedures are required by the change-over to computers. Finally, the cost of obtaining a machine and software are quite small for the tasks involved and are easily off-set by the cost savings realized from use of the machine.

Having successfully used computers for labor intensive, clerical tasks, the firm enters Stage 2 where additional routine functions are programmed. In fact, the computer takes on so many routine functions that Stage 3 in the adoption process requires an effort to more effectively ration and schedule the available computer resources. Stage 4 brings a radical alteration in the use of the computer. Instead of taking over the work of users, the machine now works with users. A whole new set of behaviors and work habits are required. Parallel stages can be identified in other organizations. For example, early use of computers in education revolved around such routine tasks as grading, record keeping, and scheduling. Only recently have educational organizations begun to experiment with computers as teaching aids.

It is in Stage 4 of the adoption process that real resistance to the use of computers has emerged, largely because work of a managerial and professional nature is typically in conflict with the computer based technology offered (Rockart 1979). Radical alterations in the way individuals and organizations deal with information are required and these changes often run counter to deeply held beliefs and values. Dubois (1972) has found that the greater the incompatibility of an innovation with a deeply held belief or value the less likely that the innovation will be adopted. To obtain adoption of computer based technologies in this case is quite difficult and will generally require considerable efforts to overcome resistance.

Zaltman and Wallendorf (1979) have summarized much of the literature on resistance to innovation. In general, this literature suggests that outsiders will be less effective as agents of change than persons known and accepted by the organization. This would suggest that it is important to identify persons in an organization who will be likely to both try the new technology and who are credible with other members of the organization. How might these individuals be identified? Research on the characteristics of innovators (Boone 1970, Rogers and Stanfield 1968, King 1964), Robertson 1971, Kegerreis, Engel, and Blackwell 1970) is not very helpful on this point. Innovators seem to vary by product class and have few distinguishing personality characteristics. Such persons do tend to be more knowledgeable generally, are more venturesome, have more positive attitudes toward change, higher achievement motivation, are more cosmopolitan, and frequently are more mobile. Mental rigidity, dogmatism or satisfaction with life is likely to decrease innovation proneness (Engel and Blackwell 1982). Higher education and social status also appear to be related to innovation proneness. Persons possessing many of these traits are good targets for entry into an organization. Even if these individuals know little about computer technologies they are most likely to be receptive to information about it. They are also good candidates for becoming internal experts on such systems. By making use of a rather common tactic used by commercial marketers, training and education of these insiders, a nucleus of internal users and advocates may be developed. Workshops, special programs, or other measures may be useful for developing this expertise.

Once the most likely innovators in an organization have been identified it is important to provide information to these potential innovators. It is particularly important to emphasize the relative advantages of the innovation,

in the present case, computer based technologies. Care should be taken not to oversell the system, however. The less clear the communications about the advantages of the system and the less convincing that information the less likely further information will be sought. Ligon (1978) has suggested that one of the biggest obstacles to the acceptance of computer systems is the over-promising of benefits. Benefits should be clear and available alternatives should be compared to the options offered by the system. A good example here is the much touted communications abilities of computers. But there are limits to the practicality of these systems which are often not emphasized. One currently available service will provide newspapers and other printed matter by electronic transmission over the telephone. However, with current sending and receiving capabilities it will take the average system about seven hours to receive the average newspaper at a cost of $35.00 - - - and the comics, pictures, and advertisements will be missing (Lu, 1982). A potential user will be greatly disappointed if he/she has been led to believe that an important advantage is actually impractical and will be more skeptical of other claims. Young's paper (1982) places much emphasis on this information acquisition activity.

Providing an opportunity for trial and insuring successful trial is equally important. Making trial a helpful and positive experience is the emphasis of Flanagan's paper. It is important that trial take place where dysfunctional consequences can be minimized. Trial on a limited basis for limited applications coupled with an easy retreat route is important to gaining acceptance of the system (Ostlund, 1974). The LINK systems provides this type of trial. Once satisfactory trial on a limited basis has occurred more applications can be added. The result of this extended trial period should be the development of strong internal advocates for the adoption of the technology.

Internal advocates will have greater credibility for others in the organization and will facilitate the adoption process. It is important that some of these internal advocates be senior supervisory personnel, managers, or administrators. Lucus (1975) and Ligon (1978) both conclude that lack of top-level administrative support is a common reason for the rejection of computer based technologies in organizations. This is consistent with the conclusion drawn by Zaltman and Wallendorf (1980) that the greater the opposition among group leaders the less likely an innovation will be accepted.

Developing internal advocates and insuring satisfactory trial do not complete the adoption process however. Resistance may still be substantial. If an innovation is perceived by one group within an organization to enhance the power of another group, the former group will tend to resist the change (Zaltman and Wallendorf, 1980). Fears that the computer will become a tool of the priviledged abound (see for example, Turkinton's recent article in the APA Monitor, Turkington 1982). The greater the solidarity of the threatened group, the stronger will be the resistance (Dubois 1972). One approach to reducing resistance is the establishment of work teams which are introduced to the system together and whose members serve as consultants to one another. This is a procedure long recognized in the organizational development literature (French and Bell 1978). It is also critical that organizational procedures be modified to encourage the use computer technologies.

Human factors must also be considered as was pointed out by Dos Santos. Systems must be made comfortable for users and an understanding of how human beings interest with and use information as well as the particular hardware and software is necessary. Indeed, it is probably not advantageous to implement systems directly "off-the-shelf" since such systems may lack the special features and capabilities required of a particular set of users. Both

Ligon (1978) and Lucus (1975) argue that obtaining user cooperation in the initial design and later evolution of a computer system are critical to insuring support and utilization. Not only does such user cooperation more nearly match system capabilities to user needs, it also gives users a vested interest in the system, identifies users with the system, and sets the stage for further adaptation of the system in the future.

May Weber (1976) has suggested that the dominating force behind resistance to complex technologies is fear - - - fear of inadequacy, fear of obsolescence. Other objections to computer technologies may simply mask this more fundamental fear. The key to overcoming resistance lies in elminating the underlying fear.

Consumer psychologist and others involved in the marketing of new products have developed considerable experience with techniques for overcoming resistance to innovation. Persons or organizations who are charged with the task of implementing computer based technologies would do well to review the work of these professionals. Among the practices frequently employed are some of the same practices already discussed by the other panelists: 1) implementation assistance, 2) the creation of opinion leaders and experts, 3) emphasizing relative advantages, 4) developing opportunities for limited trial, 5) incorporating user suggestions into the final system design, and 6) trying to insure that organizational rules and procedures are compatible with the requirements for effective system utilization. A good starting place for reviewing this literature is the bibliography complied by Rogers and Thomas (1975). We are embarking on a revolution that has been called more dramatic than the industrial revolution. That revolution will be painful for some, disconcerting to some, threatening to many, and will impact nearly everyone. Perhaps we as psychologists can employ some of what we have learned to facilitate the inevitable transition to a computer-oriented society.

## References


Boone, L.E. (1970), "The Search for the Consumer Innovator," Journal of Business, 43 (April), 135-140.

Demb, A. (1979), Computer Systems for Human Systems, New York: Pergamon Press.

Dos Santos, B. (1982), "Human Factors and the Design of Information Systems," Proceedings of the Division of Consumer Psychology of the American Psychological Association, forthcoming.

DuBois, B. (1972), "A Cultural Approach to the Study of Diffusion and Adoption of Innovations," in M. Venkatesan (Ed.), Proceedings of the Third Annual Conference of the Association for Consumer Research, 840-850.

Engel, J.F. and R.D. Blackwell (1982), Consumer Behavior, 4th Edition, New York: Dryden Press.

Flanagan, M. (1982), "Diffusion of Executive Information Support Systems through a Link Strategy," Proceedings of the Division of Consumer Psychology of the American Psychological Association, forthcoming.

French and Bell (1978), Organizational Development, 2nd Ed., Englewood Cliffs, N.J.: Prentice-Hall.

Gibson, C.F. and R.L. Nolan (1974), "Managing the Four Stages of EDP Growth," Harvard Business Review, 52, 76-88.

Katz, E., M.L. Levin, and H. Hamilton (1963), "Traditions of Research on the Diffusion of Innovation," American Sociological Review, 28, 237-252.

Keen, P. (1976), "Managing Organizational Change: The Role of MIS," Proceedings of the Seventh Annual Conference, Society for MIS, Chicago: The Society for Management Information Systems.

Kegerreis, R.J., J.F. Engel, R.D. Blackwell (1970), "Innovativeness and Diffusiveness: A Marketing View of the Characteristics of Earliest Adopters, in Kollat, Blackwell and Engel (Eds.), Research in Consumer Behavior, New York: Holt, Rinehart, and Wintson, 671-689.

Kenny, D.P. (1978), Minicomputer, Low-Cost Computer Power for Management, revised edition, New York, AMACOM.

King, C.W. (1964), "The Innovator in the Fashion Adoption Process," in L.G. Smith (Ed.), Reflections on Progress in Marketing, Chicago: American Marketing Association, 324-339.

Ligon, H.H. (1978), Successful Management Information Systems, UMI Research Press.

Lu, C. (1982), "What Good Are Home Computers?," Science 82, 3 (6), 18.

Lucus, H.C., Jr. (1978), Why Information Systems Fail, New York: Columbia University Press.

Ostlund, L.E. (1974), "Perceived Innovation Attributes as Predictors of Innovativeness," Journal of Consumer Research, 1 (Sept.), 23-29.

Rockart, J.F. (1979), "Chief Executives Define their Own Data Needs," Harvard Business Review, 57, 81-93.

Robertson, T.S. (1971), Innovative Behavior and Communication, New York: Holt, Rinehart, and Winston.

Rogers, E.M. and J.D. Stanfield (1968), "Adoption and Diffusion of New Products: Emerging Generalizations and Hypotheses," Bass, F.M., et al (Eds.), Applications of the Sciences to Marketing Management, New York: John Wiley.

Rogers, E.M. and P.C. Thomas (1975), Bibliography on the Diffusion of Innovations, Ann Arbor, MI: Dept. of Population Planning, University of Michigan.

Turkington, C. (1982), "Computers in Class: Who Gets to Learn?," APA Monitor, June, 1, 30.

Weber, M. (1976), "A Psychoanalytic Approach to MIS," Proceedings of the Sixth Annual Conference of the Society for Management Information Systems, Chicago: The Society for Management Information Systems.

Young, M. (1982), "Issues in the Dissemination of Education Microcomputer Technology," Proceedings of the Division of Consumer Psychology of the American Psychological Association, forthcoming.

Zaltman, G. and M. Wallendorf (1979), Consumer Behavior: Basic Findings and Management Implications, New York: John Wiley.